

METRIC

MIL-PRF-27407B  
25 August 1997  
SUPERSEDING  
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28 November 1978

## PERFORMANCE SPECIFICATION

### PROPELLANT PRESSURIZING AGENT, HELIUM

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers the requirements for two grades and two types of helium.

1.2 Classification. The helium will be of the following types and grades as specified (6.2):

1.2.1 Types. The types of helium are as follows:

Type I - Gaseous

Type II - Liquid

1.2.2 Grades (Type I only). The grades of helium are as follows:

Grade A - Pressurizing

Grade B - Respirable

#### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to SA-ALC/SFSP, 1014 Billy Mitchell Blvd/STE 1, Kelly AFB TX 78241-5603, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9135

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM E 29 - Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103-1187.)

COMPRESSED GAS ASSOCIATION (CGA)

- CGA G-9.1 - Commodity Specification for Helium
- CGA P-15 - Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders

(Application for copies should be addressed to the Compressed Gas Association, Inc, 1725 Jefferson Davis Highway, Arlington VA 22202-4100.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Grade requirements.

3.1.1 Type I. The purity and impurity concentrations as applicable to each grade of helium shall conform to the limits of Table I when tested in accordance with the applicable test method also specified in Table I. Limits and tests may be added or deleted by the procuring activity (see 6.2).

3.1.2 Type II. The liquid shall pass the helium assurance test of 4.5.

3.2 Limiting values. The following applies to all specified limits in this specification: For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM Practice E 29 for using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. Unless otherwise specified (6.2), Types I and II need not be filtered.

3.4 Filled containers (Type I only).

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3.4.1 Pressure. Cylinders and tubes shall be within 99 to 100 percent of rated service pressure when tested as specified in 4.6.1. Pressure-Temperature Filling Charts in CGA P-15 may be used.

3.4.2 Leakage. Cylinders shall not leak when tested according to 4.6.2.

TABLE I. Grade limits for helium (Type I only)<sup>1</sup>

	Grade		Test Method
	A	B	
Purity, % by vol, min	99.995	99.997	4.4.1
Impurities, ppm by vol, max	50		4.4.2
Water	9	9	4.4.2
Hydrocarbons (as methane)	5	1	4.4.2
Oxygen	3	3	4.4.2
Nitrogen + argon	14	5	4.4.2
Neon	23	23	4.4.2
Hydrogen	1	1	4.4.2
Carbon dioxide	1		4.4.2
Carbon monoxide	1		4.4.2
<sup>1</sup> For Type II requirements see 3.1.2.			

#### 4. VERIFICATION

4.1 Points of inspection (6.2). Unless otherwise specified, acceptance tests shall be conducted at the site of filling prior to shipment or departure.

4.2 Conformance inspection. Quality conformance tests shall consist of the following:

- a. Individual tests (Type I only) . . . . 4.2.1
- b. Sampling tests . . . . . 4.2.2

4.2.1 Individual tests (Type I only). Each container (cylinder or tube) shall be subjected to the following tests as described under 4.6:

- a. Filling pressure . . . . 4.6.1
- b. Leakage . . . . . 4.6.2

4.2.2 Sampling test. Type I helium shall be selected according to 4.2.2.1 and tested for the requirements of Table I as specified in 4.4. Type II helium shall be selected according to 4.2.3 and tested for the requirements of 3.1.2 as specified in 4.5.

4.2.2.1 Sampling plan (Type I).

4.2.2.1.1 Lot. When helium gas cylinders or tubes are filled, each set of cylinders or tubes charged on the same manifold at the same time shall constitute a lot. Tubes that are interconnected shall be considered as one lot for the purpose of this specification. The number of samples per lot shall conform to Table II.

TABLE II. Sampling for test

Number of containers in lot	Number of containers to be sampled
1	1
2 - 40	2
41 - 70	3
71 - over	4

4.2.3 Sampling Plan (Type II). One sample shall be taken from each lot.

4.2.3.1 Lot. A lot shall consist of one of the following:

a. The helium produced in not more than 24 consecutive hours from a continuous process which is used to fill shipping containers directly from the process output. A continuous process shall be the production of product by continuous input of raw materials and output of finished product by one manufacturer in one plant with no change in manufacturing conditions or materials.

b. The helium from individual runs of a batch process which is used to fill shipping containers directly from the process output. A batch process shall be the production of product by runs from single additions of raw materials which are reacted and purified forming the product.

c. The helium from either or both the continuous and batch processes which is held in a single storage tank and subsequently withdrawn to fill shipping containers. The product shall be homogeneous at the time of withdrawal and shall not be added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.2.4 Sample. Each sample shall be of sufficient size to conduct all the quality conformance tests as specified herein. Unless otherwise specified, the quality conformance tests shall be made of each required sample (6.2). When required, an equivalent sample shall be forwarded to a laboratory designated by the procuring activity for testing.

4.3 Rejection. When any sample tested in accordance with 4.4 or 4.5 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected. Unless otherwise specified,

disposition of rejected product shall be specified by the procuring activity (6.2).

4.4 Analytical procedures (Type I). Unless otherwise specified, samples shall be analyzed according to the procedures described below (6.2). Calibration gas standards may be required to calibrate (zero and span) analytical instruments used to determine the purity and impurity contents of the helium. The accuracy of the calibration gas standards is to be traceable to the National Institute of Standards and Technology.

4.4.1 Purity. The helium percent shall be found by determining the aggregate impurities by the methods of CGA G-9.1. The percent helium is the value obtained when this amount expressed as volume percent is subtracted from 100.

4.4.2 Gaseous impurities. Methods shall be selected from those of CGA G-9.1.

4.5 Helium assurance test (Type II). Liquid helium is generally assumed to be extremely pure because contaminants have been removed during the early stages of the liquefaction process which occurs at 4.2°K (-268.9°C). It follows that assuring that the fluid is helium is sufficient to verify a contaminant free product. The requirement for ensuring that the loaded fluid is liquid helium can be satisfied by

a. Analyzing the vent gas from one of the shipping containers or the storage tank from which the shipping containers are filled (thermal conductivity, mass spectrometer, etc); or

b. Demonstrating that the fluid in one of the shipping containers or the storage tank from which the shipping containers are filled is below the hydrogen triple point (13.8°K).

#### 4.6 Containers of Type I helium.

4.6.1 Filling pressure. Samples shall be tested for proper filling pressure by attaching a calibrated Bourdon-tube gauge or equivalent to the valve outlet and by attaching either a thermocouple or thermometer to the container wall. The gauge shall have scale divisions not greater than 100 kPa (15 psi). If a thermometer is used, tape or putty shall be applied to the bulb to protect it from extraneous temperatures. Putty shall not be applied between the bulb and the cylinder wall. The thermometer shall have scale divisions not greater than 1°C (2°F). The containers shall be stabilized to ambient temperature. Then the valve shall be opened and the internal pressure observed on the gauge.

4.6.2 Leakage. Each Type I helium container shall be tested for leaks at the neck threads, stem packing, and safety device of the valve with leak-detection fluid. Valve seat leakage shall be tested by means of a tube from the valve outlet to a container of liquid.

### 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual

packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. Type I, Grade A helium is intended for pressurization of rocket engine propellant systems, space vehicles and associated ground support equipment, welding and other shielding gas operations. Type I, Grade B helium is intended for use as a respirable breathing gas for divers during deep excursions into the oceans. Type II helium is intended for use as a cryogenic coolant in specialized test and measurement equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Type and grade required, if applicable (1.2). Only Type I has grades.
- c. Issue of DoDISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (2.2).
- d. Method of shipment, type and capacity of containers.
- e. When limits or tests are to be added or deleted (3.1.1).
- f. When filtration is required (3.3).
- g. When variation in points of inspection is granted (4.1).
- h. When conformance tests on each sample are not required (4.2.4).
- i. When disposition of rejected product is to be made by other than the procuring activity (4.3).
- j. When other analytical procedures are to be used (4.4).

6.3 Packaging requirements. Guidance for cylinders may be found in the following documents:

- a. RR-C-901 - Cylinder, Compressed Gas, High Pressure, Steel DOT 3AA, and Aluminum Applications, General Specification For
- b. MIL-STD-101 - Color Code for Pipelines and for Compressed Gas Cylinders

- |    |                  |   |   |
|----|------------------|---|---|
| c. | MIL-STD-1411     | - | Inspection and Maintenance of Compressed Gas Cylinders            |
| d. | 49 CFR 171 - 199 | - | Code of Federal Regulations                                       |
| e. | CGA C-6          | - | Standards for Visual Inspection of Steel Compressed Gas Cylinders |

6.4 Part or identifying number (PIN). The PINs to be used for helium acquired to this specification are created as follows:

M 27407 - X X      Example of PIN: M27407-1B

└─ Grade (see 1.2.2).

└─ Type (see 1.2.1). Use 1 for Type I; 2 for Type II.

└─ Specification number.

└─ Prefix for military specification.

6.5 Subject term (key word listing).

Aerospace  
Breathing  
Coolant  
Cryogenic  
Cylinders  
Divers  
Propellant  
Space vehicle

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians  
Navy - AS  
Air Force - 68

Preparing Activity  
Air Force - 68

Civil Agency Interest  
NASA

Review Activities  
Air Force - 19

(Project 9135-0145)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

### I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER  
MIL-PRF-27407B

2. DOCUMENT DATE (YYMMDD)  
970825

### 3. DOCUMENT TITLE

Propellant Pressurizing Agent, Helium

### 4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

### 5. REASON FOR RECOMMENDATION

### 6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)  
(1) Commercial  
(2) AUTOVON  
(If applicable)

7. DATE SUBMITTED  
(YYMMDD)

### 8. PREPARING ACTIVITY

a. NAME

SA-ALC/SFSP

b. TELEPHONE (Include Area Code)  
(1) Commercial  
(2) AUTOVON  
(210) 925-7847

(2) AUTOVON  
945-7847

c. ADDRESS (Include Zip Code)

1014 Billy Mitchell Blvd, STE 1  
Kelly AFB, TX 78241-5603

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:  
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